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(71) Applicant: **Ford Motor Company**
Dearborn, MI 48126 (US)

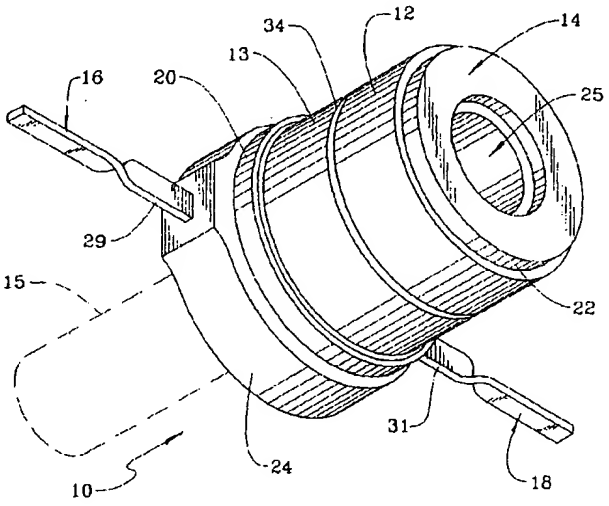
(72) Inventors:
- **York, Michael Timothy**
  Whitmore Lake, Michigan 48189 (US)
- **Harris, Richard Kenneth**
  Walled Lake, Michigan 48390 (US)

(74) Representative: **Messulam, Alec Moses et al**
A. Messulam & Co.,
24 Broadway
Leigh-on-Sea, Essex SS9 1BN (GB)

(54) Slip ring assembly with reinforcement ring

(57) The present invention is a slip ring assembly (10) for an automotive alternator, or other appropriate rotary electric machine, which includes at least one slip ring (12,13), a plastic body (14) mounting the slip ring, at least one electrical terminal (16,18) connected to the slip ring and supported by the body and at least one reinforcement ring (20). The reinforcement ring (20) is operatively disposed on the plastic body (14) and operatively adapted so as to strengthen the slip ring assembly (10) against catastrophic failure resulting from loads applied to the slip ring assembly while it is under severe operating conditions. By employing such a reinforcement ring, the present slip ring assembly can be produced inexpensively with plastic bodies made from polyester and like plastics and yet still be able to withstand operating loads applied under high rotational speeds, elevated temperatures and other adverse conditions.

FIG. 1



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Description

The present invention is related to slip ring assemblies mounted on the rotor of automotive alternators, and more particularly to an alternator slip ring assembly with a reinforcement ring.

Slip ring assemblies are used in the automotive industry to transfer power from the brushes to the coil of an alternator. A typical slip ring assembly, like that disclosed in U.S. Patent Nos. 5,327,037 and 4,535,264, includes a moulded body made from electrically insulating plastic, one or more electrically conductive slip rings mounted around the outside of the body, and two electrical terminals embedded in the plastic body and electrically connected to the slip rings.

The assembly body is usually moulded out of either a polyester or phenolic plastic. Slip ring assemblies with bodies made of polyester plastic often fail catastrophically because they are not strong enough to withstand the dynamic loading they receive while in use, especially at elevated temperatures and high rotational speeds. Slip ring assemblies with bodies made of phenolic plastic are typically strong enough to survive such adverse conditions. However, phenolic plastic bodies are more expensive to produce than polyester plastic bodies.

Accordingly, there is a need for an improved slip ring assembly that is relatively inexpensive to produce but still suitably resistant to catastrophic failure, while being subjected to applied loads under severe operating conditions, such as high rotational speeds, elevated temperatures and the like.

The present invention provides a slip ring assembly for an automotive alternator, or other appropriate rotary electric machine, wherein the slip ring assembly includes at least one slip ring, a plastic body mounting the slip ring, at least one electrical terminal connected to the slip ring and supported by the body and at least one reinforcement ring. The reinforcement ring is operatively disposed on the plastic body and operatively adapted so as to strengthen the slip ring assembly against catastrophic failure resulting from loads applied to the slip ring assembly while it is under severe operating conditions. By employing such a reinforcement ring, the present slip ring assembly can be produced inexpensively with plastic bodies made from polyester and like plastics and yet still be able to withstand operating loads applied under high rotational speeds, elevated temperatures and other adverse operating conditions.

Slip ring assemblies typically include a plastic body having a tubular hub mounting the slip ring and a base mounting the terminal. It has been found desirable to embed the reinforcement ring around the base of the body. The terminals used in slip ring assemblies are often generally L-shaped with a foot section that is electrically attached to the slip ring. For any type of terminal with such a foot section, it has been found desirable to dispose the reinforcement ring to surround each foot section.

The reinforcement ring can be a closed ring which extends an entire 360°. Alternately, the reinforcement ring can be open or notched such that it extends less than 360°. It may be desirable to include hooks at the ends of open or notched reinforcement rings for retention in the slip ring assemblies.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which :

Fig. 1 is a perspective view of one embodiment of the present slip ring assembly;
Fig. 2 is a front view of the embodiment of Fig. 1;
Fig. 3 is a cross sectional view taken along lines 3-3 in Fig. 2; and
Fig. 4 is a front view of an open or notched reinforcement ring.

Although the present invention is herein described in terms of a specific embodiment, it will be readily apparent to those skilled in this art that various modifications, rearrangements, and substitutions can be made without departing from the spirit of the invention. The scope of the present invention is thus only limited by the claims appended hereto.

Referring to Figs. 1-3, one embodiment of the present invention is a slip ring assembly 10 intended for mounting on a shaft 15 (shown in phantom) of a rotary electric machine, such as the rotor shaft of a motor vehicle alternator, like that disclosed in U.S. Patent No. 5,327,037, which is incorporated herein by reference, in its entirety. Slip ring assembly 10 includes two slip rings 12 and 13, a plastic body 14 mounting the slip rings 12 and 13, and two electrically conductive terminals 16 and 18 which are embedded in the plastic body 14 and electrically connected to the slip rings 12 and 13, respectively. A reinforcement ring 20 is operatively disposed on the plastic body 14 and operatively adapted so as to strengthen the slip ring assembly 10 against catastrophic failure resulting from loads applied to the slip ring assembly 10 while it is being rotated by the rotor shaft 15.

The body 14 is preferably of moulded plastic construction with a tubular hub section 22 at its leading end, a base section 24 at its rear end and a central bore 25 formed through the hub 22 and base 24. Suitable plastics for moulding body 14 include glass filled thermoset polyester and polyphenylene sulphide. Those skilled in the art will appreciate that alternative materials may also be used to form the body 14 of slip ring assembly 10. The body 14 is operatively adapted for receiving the rotor shaft 15 through bore 25 so as to rotate with the rotor shaft 15 around its axis of rotation. Hub 22 serves to support and insulate slip rings 12 and 13 from each other and from the rotor shaft 15.

The slip rings 12 and 13 are usually made of copper. Slip ring 12 includes a tab 26 which is embedded into the plastic body 14 during the moulding process. Each of the terminals 16 and 18 is typically made of a weldable

steel of sufficient electrical conductivity. Each terminal 16 and 18 is generally L-shaped with a foot section 28 and 30 and a leg section 29 and 31, respectively. The foot sections 28 and 30 are moulded in place into the base 24 of body 14. The foot section 28 is electrically attached to the slip ring 12, such as by soldering or welding to the tab 26. The foot section 30 is likewise electrically attached directly to the slip ring 13.

For any type of terminal with a foot section, it has been found desirable to space the reinforcement ring 20 away from the leg sections 29 and 31 so as to surround each of the foot sections 28 and 30, as shown in Fig. 3. The reinforcement ring 20 extends around the base 24 and is secured thereto, preferably, by being integrally moulded or otherwise embedded partially or totally into the plastic body 14. The reinforcement ring 20 can be made of any suitable material of sufficient strength to provide the desired reinforcement, such as a metal or metal alloy (e.g., a 3003 aluminium alloy) or a composite material (e.g., a continuous filament wound glass fibre composite).

If made of an electrically conductive material, the reinforcement ring 20 should be embedded in body 14 so as to be electrically isolated, by a suitable barrier of insulating material, from the slip rings 12 and 13 as well as both terminals 16 and 18. An electrically conductive reinforcement ring 20 can be electrically isolated by positioning the reinforcement ring 20 so that the plastic of the body 14 forms the barrier. It may also be desirable to cover the reinforcement ring 20 with a separate insulating layer or coating (not shown) before being made a part of the assembly 10.

As shown in Figs. 1-3, the reinforcement ring 20 is a closed ring which extends an entire 360° around the body 14. Alternately, a reinforcement ring 20a can be open or notched such that it extends less than 360°. The reinforcement ring 20a is shown schematically in Fig. 4 as it preferably is positioned relative to the foot sections 28 and 30 of the terminals 16 and 18, respectively.

If an open or notched reinforcement ring, such as the reinforcement ring 20a, is utilised, it must be made sufficiently rigid so as to provide the support necessary to properly reinforce the slip ring assembly 10. It may be desirable to include hooks 20h at the ends of the open or notched reinforcement ring 20a for retention of the reinforcement ring 20a in the body 14 of the slip ring assembly 10. It should be understood that a variety of open and closed reinforcement rings can be used in the present invention and the term "reinforcement ring" is used in the claims to generally refer to all such reinforcement rings unless specifically defined therein.

Slip ring assembly 10 can be constructed by first soldering, welding or otherwise making an electrical connection between the terminal foot sections 28 and 30 and the corresponding slip rings 12 and 13. Once connected in this manner, the terminals 16 and 18 and the slip rings 12 and 13 are placed within an appropriately configured mould (not shown). The mould is filled with an appropriate plastic material to form body 14 in a conventional manner. For ease of manufacture, the slip rings 12 and 13 can begin as a single annular band or shell when inserted into the mould. Once the body 14 is formed and the moulding process completed, the slip rings 12 and 13 are separated from one another by machining, cutting or otherwise forming a circumferential notch 34 in the annular band.

By employing a reinforcement ring, such as one of the reinforcement rings 20, 20a, the slip ring assembly 10 can be produced inexpensively with plastic bodies made from less expensive polyester and like plastics and yet still be able to withstand operating loads applied under high rotational speeds, elevated temperatures and other adverse operating conditions.

Claims

1. A slip ring assembly for a rotary electric machine, said slip ring assembly comprising:

   a plastic body (14);
   at least one slip ring (12,13) mounted to said body (14);
   at least one electrical terminal (16,18) connected to said slip ring (12,13) and supported by said body (14); and
   at least one reinforcement ring (20) operatively disposed on said body (14) and operatively adapted so as to strengthen said slip ring assembly (10) against catastrophic failure resulting from loads applied to said slip ring assembly while in operation with a rotary electric machine.

2. A slip ring assembly as claimed in claim 1, wherein said plastic body includes a tubular hub receiving said slip ring with a base supporting said terminal, and said reinforcement ring is disposed at least partially around said base.

3. A slip ring assembly as claimed in claim 2, wherein said reinforcement ring is embedded at least partially in said base.

4. A slip ring assembly as claimed in claim 1, wherein said reinforcement ring is integrally moulded into said body.

5. A slip ring assembly as claimed in claim 1, wherein said terminal is L-shaped with a lower foot section embedded in said base, and said reinforcement ring is disposed around said base and said foot section.

6. A slip ring assembly as claimed in any one of the preceding claims, wherein said reinforcement ring is made of aluminium.

7. A slip ring assembly as claimed in any one of claims 1 to 5, wherein said reinforcement ring is made of a composite material.

8. A slip ring assembly for an alternator rotor assembly, said slip ring assembly comprising:

at least one electrically conductive slip ring;
an electrically insulating body mounting said slip ring;
at least one electrically conductive terminal with a foot section embedded in said body and connected to said slip ring; and
at least one reinforcement ring operatively disposed around at least a portion of said body and said foot section so as to strengthen said slip ring assembly.

9. A slip ring assembly as claimed in claim 8, wherein said reinforcement ring is embedded at least partially in said body.

10. A slip ring assembly for an alternator rotor assembly, said slip ring assembly comprising:

at least one electrically conductive slip ring;
an electrically insulating plastic body having a hub mounting said slip ring and a base;
two L-shaped electrically conductive terminals, each with a foot section embedded in the base of said body and connected to said at least one slip ring; and
a reinforcement ring embedded in the base of said body and around each said foot section and operatively adapted for strengthening said slip ring assembly against catastrophic failure resulting from stresses applied to said slip ring assembly while in operation with an alternator rotor assembly.

FIG. 1

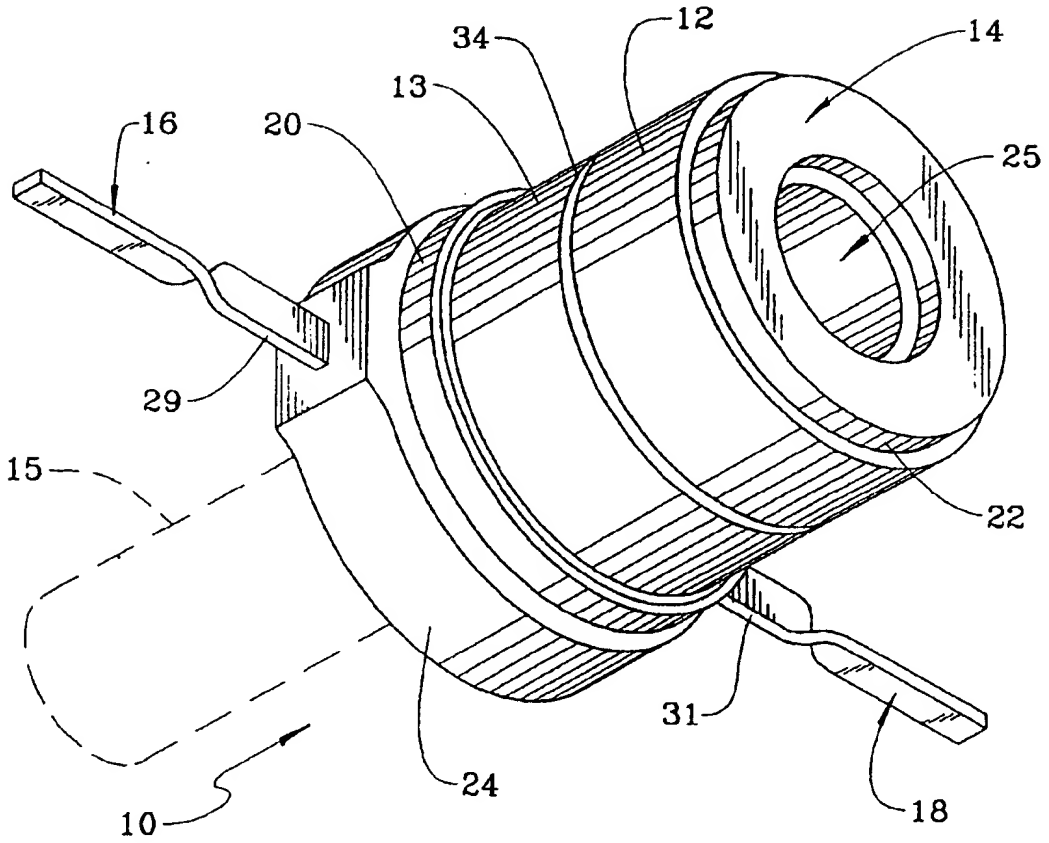

FIG. 4

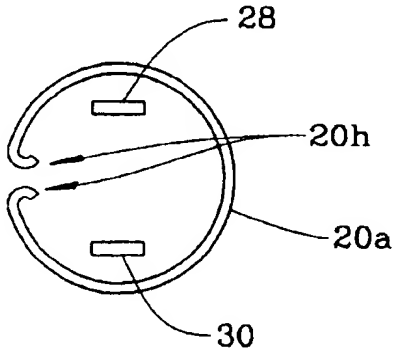

FIG. 3

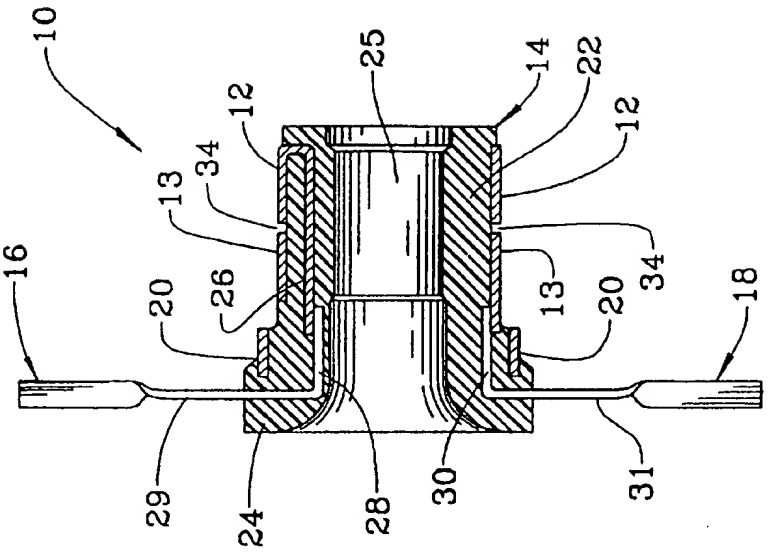
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FIG. 2

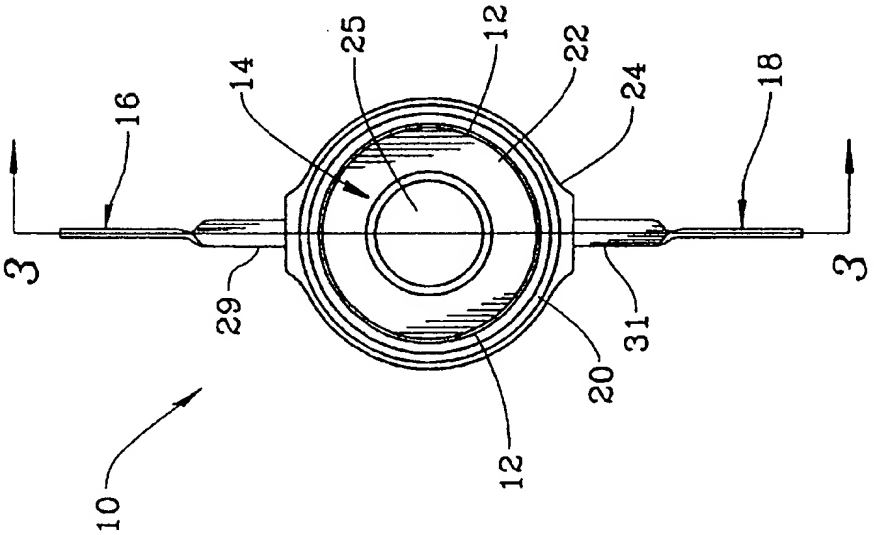
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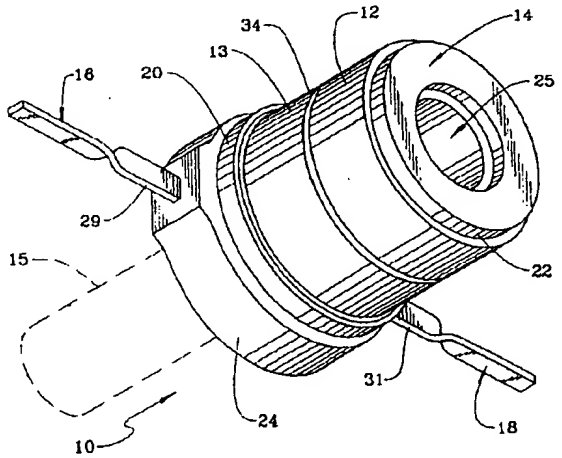
FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 3288

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y,D	US-A-4 535 264 (ALLPORT MAURICE J) 13 August 1985 * abstract *	1,4	H01R39/08 H01R39/34
Y	US-A-1 597 887 (HIMES) 31 August 1926 * page 1, line 90 - line 96; figure *	1,4	
A		8,10	
A	US-A-3 842 301 (SMITH R) 15 October 1974 * figures 1,2 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 005, no. 051 (E-051), 10 April 1981 & JP-A-56 003553 (HITACHI LTD), 14 January 1981, * abstract *	1	
A	DE-A-38 23 844 (KAUTT & BUX KG) 18 January 1990 * abstract *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01R H02K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 December 1996	Zanichelli, F

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